Appendix I1: Monroe Life History Parameter Values

The tables in this appendix present the life history parameter values used by EPA to calculate age 1 equivalents, fishery yields, and production foregone from I&E data for the Monroe facility.

Table I1-1: Alewife Parameters

Stage Name	Natural Mortality (per stage)[a]	Fishing Mortality (per stage)[b]	Fraction Vulnerable to Fishery[b]	Weight (lb)
Eggs	11.5	0	0	0.000022[c]
Larvae	5.5	0	0	0.011[c]
Age 1+	0.5	0	0	0.016[a]
Age 2+	0.5	0	0	0.0505[a]
Age 3+	0.5	0	0	0.0764[a]
Age 4+	0.5	0	0	0.0941[a]
Age 5+	0.5	0	0	0.108[a]
Age 6+	0.5	0	0	0.13[a]
Age 7+	0.5	0	0	0.149[a]

[a] Spigarelli et al., 1981.
[b] Not a commercial or recreational species, thus no fishing mortality.
[c] Assumed based on Spigarelli et al. (1981).

Table I1-2: Bluegill Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[d]	Fraction Vulnerable to Fishery[e]	Weight (lb)[f]
Eggs	1.73[a]	0	0	0.0000000108[g]
Larvae	0.576[a]	0	0	0.00000156[g]
Age 0+	4.62[a]	0	0	0.00795[h]
Age 1+	0.39[b]	0	0	0.00992[h]
Age 2+	0.151[c]	0	0	0.032[h]
Age 3+	0.735[d]	0.735	0.5	0.0594[h]
Age 4+	0.735[d]	0.735	1	0.104[h]
Age 5+	0.735[d]	0.735	1	0.189[h]
Age 6+	0.735[d]	0.735	1	0.193[h]
Age 7+	0.735[d]	0.735	1	0.209[h]
Age 8+	0.735[d]	0.735	1	0.352[h]
Age9+	0.735[d]	0.735	1	0.393[h]

[a] Bartell and Campbell, 2000.
[b] Froese and Pauly, 2001.
[c] Calculated from survival (Carlander, 1977) using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[d] Carlander, 1977. Assumed half of total mortality was natural and half was fishing.
[e] Recreational species. Fraction vulnerable assumed.
[f] Weight calculated from length using the formula: $(4.33 \times 10^{-6}) * \text{Length(mm)}^{3.209}$ = weight(g) (Froese and Pauly, 2001).
[g] Length from Wang (1986a).
[h] Length from Carlander (1977).

Table I1-3: Bullhead Species Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[d]	Weight (lb)[e]
Eggs	2.3[a]	0	0	0.000000559[f]
Larvae	4.61[b]	0	0	0.00018[g]
Age 0+	1.39[b]	0	0	0.00132[h]
Age 1+	0.223[c]	0.223	0.5	0.0362[h]
Age 2+	0.223[c]	0.223	1	0.0797[h]
Age 3+	0.223[c]	0.223	1	0.137[h]
Age 4+	0.223[c]	0.223	1	0.233[h]
Age 5+	0.223[c]	0.223	1	0.402[h]
Age 6+	0.223[c]	0.223	1	0.679[h]
Age 7+	0.223[c]	0.223	1	0.753[h]
Age 8+	0.223[c]	0.223	1	0.815[h]
Age9+	0.223[c]	0.223	1	0.823[i]

[a] Calculated from assumed survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Calculated from survival for channel catfish (Geo-Marine Inc., 1978) using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Calculated from survival for brown bullhead (Carlander, 1969) using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality). Assumed half of total mortality was natural and half was fishing.
[d] Commercial species. Fraction vulnerable assumed.
[e] Weight calculated from length using the formula for black bullhead: $(8.797 \times 10^{-6}) * \text{Length(mm)}^{3.06}$ = weight(g) (Froese and Pauly, 2001).
[f] Length for black bullhead from Wang (1986a).
[g] Length assumed based on Wang (1986a) and Carlander (1969).
[h] Length for black bullhead from Carlander (1969).
[i] Length assumed based on Carlander (1969).

Table I1-4: Burbot Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[d]	Weight (lb)[e]
Eggs	2.3[a]	0	0	0.0000000120[f]
Larvae	8.05[b]	0	0	0.00000144[f]
Age 1+	0.462[c]	0.1	0.5	0.129[g]
Age 2+	0.462[c]	0.1	1	0.513[g]
Age 3+	0.462[c]	0.1	1	0.842[g]
Age 4+	0.462[c]	0.1	1	1.23[g]
Age 5+	0.462[c]	0.1	1	1.99[g]
Age 6+	0.462[c]	0.1	1	2.68[g]
Age 7+	0.462[c]	0.1	1	2.97[g]
Age 8+	0.462[c]	0.1	1	3.35[g]
Age9+	0.462[c]	0.1	1	3.57[g]
Age 10+	0.462[c]	0.1	1	4.09[g]

[a] Calculated from assumed survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Calculated from extrapolated survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Calculated from survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality). Fishing mortality rate assumed based on minimal mortality (Schram et al., 1998).
[d] Commercial and recreational species. Fraction vulnerable assumed.
[e] Weight calculated from length using the formula: $(2.084 \times 10^{-6}) * \text{Length(mm)}^{3.208}$ = weight(g) (Schram et al., 1998).
[f] Length from Snyder (1998).
[g] Length from Scott and Crossman (1998).

Table I1-5: Carp Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[d]	Weight (lb)[e]
Eggs	2.3[a]	0	0	0.000000143[f]
Larvae	4.61[b]	0	0	0.0000118[f]
Age 0+	1.39[b]	0	0	0.0225[g]
Age 1+	0.13[c]	0.13	0.5	0.79[g]
Age 2+	0.13[c]	0.13	1	1.21[g]
Age 3+	0.13[c]	0.13	1	1.81[g]
Age 4+	0.13[c]	0.13	1	5.13[g]
Age 5+	0.13[c]	0.13	1	5.52[h]
Age 6+	0.13[c]	0.13	1	5.82[h]
Age 7+	0.13[c]	0.13	1	6.76[g]
Age 8+	0.13[c]	0.13	1	8.17[g]
Age9+	0.13[c]	0.13	1	8.55[h]
Age 10+	0.13[c]	0.13	1	8.94[h]
Age 11+	0.13[c]	0.13	1	9.76[h]
Age 12+	0.13[c]	0.13	1	10.2[h]
Age 13+	0.13[c]	0.13	1	10.6[h]
Age 14+	0.13[c]	0.13	1	11.1[h]
Age 15+	0.13[c]	0.13	1	11.5[h]
Age 16+	0.13[c]	0.13	1	12[h]
Age 17+	0.13[c]	0.13	1	12.5[h]

[a] Calculated from assumed survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Calculated from survival (Geo-Marine Inc., 1978) using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Froese and Pauly, 2001. Assumed half of total mortality was natural and half was fishing.
[d] Commercial species. Fraction vulnerable assumed.
[e] Weight calculated from length using the formula: $(1.095 \times 10^{-5}) * \text{Length(mm)}^{3.025}$ = weight(g) (Froese and Pauly, 2001).
[f] Length from Wang (1986a).
[g] Length from Carlander (1969).
[h] Length assumed based on Carlander (1969).

Table I1-6: Channel Catfish Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[d]	Weight (lb)[e]
Eggs	2.3[a]	0	0	0.000000408[f]
Larvae	4.61[b]	0	0	0.0000191[f]
Age 0+	1.39[b]	0	0	0.00987[g]
Age 1+	0.41[c]	0.41	0.5	0.0554[g]
Age 2+	0.41[c]	0.41	1	0.189[g]
Age 3+	0.41[c]	0.41	1	0.436[g]
Age 4+	0.41[c]	0.41	1	0.71[g]
Age 5+	0.41[c]	0.41	1	1.22[g]
Age 6+	0.41[c]	0.41	1	1.55[g]
Age 7+	0.41[c]	0.41	1	2.27[g]
Age 8+	0.41[c]	0.41	1	2.66[g]
Age 9+	0.41[c]	0.41	1	3.41[g]
Age 10+	0.41[c]	0.41	1	5.59[g]
Age 11+	0.41[c]	0.41	1	5.81[h]
Age 12+	0.41[c]	0.41	1	5.92[g]

[a] Calculated from assumed survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Calculated from survival (Geo-Marine Inc., 1978) using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Calculated from survival (Geo-Marine Inc., 1978) using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality). Assumed half of total mortality was natural and half was fishing.
[d] Commercial and recreational species. Fraction vulnerable assumed.
[e] Weight calculated from length using the formula: $(2.945 \times 10^{-6}) * \text{Length(mm)}^{3.133}$ = weight(g) (Froese and Pauly, 2001).
[f] Length from Wang (1986a).
[g] Length from Carlander (1969).
[h] Length assumed based on Carlander (1969).

Table I1-7: Crappie Parameters

Stage Name	Natural Mortality (per stage)[a]	Fishing Mortality (per stage)[b]	Fraction Vulnerable to Fishery[c]	Weight (lb)[d]
Eggs	1.8[a]	0	0	0.0000000179[e]
Larvae	0.498[a]	0	0	0.00000857[e]
Age 0+	2.93[a]	0	0	0.012[f]
Age 1+	0.292[b]	0.292	0.5	0.128[f]
Age 2+	0.292[b]	0.292	1	0.193[f]
Age 3+	0.292[b]	0.292	1	0.427[f]
Age 4+	0.292[b]	0.292	1	0.651[f]
Age 5+	0.292[b]	0.292	1	0.888[f]
Age 6+	0.292[b]	0.292	1	0.925[f]
Age 7+	0.292[b]	0.292	1	0.972[f]
Age 8+	0.292[b]	0.292	1	1.08[f]
Age9+	0.292[b]	0.292	1	1.26[f]

[a] Bartell and Campbell, 2000. Black crappie.
[b] Bartell and Campbell, 2000. Black crappie. Assumed half of total mortality was natural and half was fishing.
[c] Recreational species. Fraction vulnerable assumed.
[d] Weight calculated from length using the formula for black crappie: $(1.014 \times 10^{-5}) * \text{Length(mm)}^{3.066}$ = weight(g) (Froese and Pauly, 2001).
[e] Length for black crappie from Wang (1986a).
[f] Length for black crappie from Carlander (1977).

Table I1-8: Freshwater Drum Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[b]	Fraction Vulnerable to Fishery[c]	Weight (lb)
Eggs	2.27[a]	0	0	0.0000011[d]
Larvae	6.13[a]	0	0	0.00000295[a]
Age 0+	1.15[a]	1.15	0.5	0.0166[a]
Age 1+	0.155[b]	0.155	1	0.05[e]
Age 2+	0.155[b]	0.155	1	0.206[e]
Age 3+	0.155[b]	0.155	1	0.438[e]
Age 4+	0.155[b]	0.155	1	0.638[e]
Age 5+	0.155[b]	0.155	1	0.794[e]
Age 6+	0.155[b]	0.155	1	0.95[e]
Age 7+	0.155[b]	0.155	1	1.09[e]
Age 8+	0.155[b]	0.155	1	1.26[e]
Age9+	0.155[b]	0.155	1	1.44[e]
Age 10+	0.155[b]	0.155	1	1.6[e]
Age 11+	0.155[b]	0.155	1	1.78[e]
Age 12+	0.155[b]	0.155	1	2[e]

[a] Bartell and Campbell, 2000.
[b] Froese and Pauly, 2001. Assumed half of total mortality was natural and half was fishing.
[c] Commercial species. Fraction vulnerable assumed.
[d] Assumed based on Bartell and Campbell (2000).
[e] Scott and Crossman, 1973.

Table I1-9: Gizzard Shad Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[d]	Weight (lb)
Eggs	2.3[a]	0	0	0.0000022[e]
Larvae	6.33[b]	0	0	0.00000663[b]
Age 0+	0.511[b]	0	0	0.0107[b]
Age 1+	1.45[c]	1.45	0.5	0.141[b]
Age 2+	1.27[c]	1.27	1	0.477[b]
Age 3+	0.966[c]	0.966	1	0.64[b]
Age 4+	0.873[c]	0.873	1	0.885[b]
Age 5+	0.303[c]	0.303	1	1.17[b]
Age 6+	0.303[c]	0.303	1	1.54[b]

[a] Calculated from assumed survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Wapora, 1979.
[c] Wapora, 1979. Assumed half of total mortality was natural and half was fishing.
[d] Commercial species. Fraction vulnerable assumed.
[e] Assumed based on Wapora (1979).

Table I1-10: Logperch Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[d]	Fraction Vulnerable to Fishery[d]	Weight (lb)[e]
Eggs	2.3[a]	0	0	3.09E-09[f]
Larvae	1.9[b]	0	0	0.000276[g]
Age 0+	1.9[b]	0	0	0.00345[f]
Age 1+	0.7[c]	0	0	0.0128[f]
Age 2+	0.7[c]	0	0	0.0274[f]
Age 3+	0.7[c]	0	0	0.0443[f]

[a] Calculated from assumed survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Calculated from extrapolated survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Froese and Pauly, 2001.
[d] Not a commercial or recreational species, thus no fishing mortality.
[e] Weight calculated from length using the formula: $(5.240 \times 10^{-7}) * \text{Length(mm)}^{6.641}$ = weight(g) (Carlander, 1997).
[f] Length from Carlander (1997).
[g] Length assumed based on Carlander (1997).

Table I1-11: Muskellunge Parameters				
Stage Name	**Natural Mortality (per stage)**	**Fishing Mortality (per stage)[d]**	**Fraction Vulnerable to Fishery[e]**	**Weight (lb)[f]**
Eggs	1.08[a]	0	0	0.000000205[g]
Larvae	5.49[b]	0	0	0.0133[h]
Age 0+	5.49[b]	0	0	0.0451[g]
Age 1+	0.15[c]	0	0	0.365[g]
Age 2+	0.15[c]	0	0	1.1[g]
Age 3+	0.15[c]	0	0	1.53[g]
Age 4+	0.15[c]	0	0	2.72[g]
Age 5+	0.15[c]	0	0	6.19[g]
Age 6+	0.15[c]	0	0	7.02[g]
Age 7+	0.15[c]	0	0	8.92[g]
Age 8+	0.15[c]	0	0	12.3[g]
Age9+	0.15[c]	0	0	13.9[g]
Age 10+	0.075[d]	0.075	0.5	16.6[g]
Age 11+	0.075[d]	0.075	1	19[g]
Age 12+	0.075[d]	0.075	1	24.2[g]
Age 13+	0.075[d]	0.075	1	25.3[g]
Age 14+	0.075[d]	0.075	1	30[g]
Age 15+	0.075[d]	0.075	1	32.4[g]
Age 16+	0.075[d]	0.075	1	34.3[g]
Age 17+	0.075[d]	0.075	1	45.6[g]
Age 18+	0.075[d]	0.075	1	45.8[h]
Age 19+	0.075[d]	0.075	1	47.7[g]
Age 20+	0.075[d]	0.075	1	48.8[h]
Age 21+	0.075[d]	0.075	1	48.9[h]
Age 22+	0.075[d]	0.075	1	49[h]
Age 23+	0.075[d]	0.075	1	49.1[h]
Age 24+	0.075[d]	0.075	1	49.2[h]
Age 25+	0.075[d]	0.075	1	49.3[h]
Age 26+	0.075[d]	0.075	1	49.4[h]
Age 27+	0.075[d]	0.075	1	49.4[h]

[a] Calculated from survival (Carlander, 1997) using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Calculated from extrapolated survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Froese and Pauly, 2001.
[d] Froese and Pauly, 2001. Assumed half of total mortality was natural and half was fishing.
[e] Recreational species. Fraction vulnerable assumed based on Pennsylvania (1999).
[f] Weight calculated from length using the formula: $(5.590 \times 10^{-6}) * \text{Length(mm)}^{3.016}$ = weight(g) (Froese and Pauly, 2001).
[g] Length from Carlander (1969).
[h] Length assumed based on Carlander (1969).

Table I1-12: Shiner Species Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[c]	Weight (lb)[d]
Eggs	2.3[a]	0	0	0.000000252[e]
Larvae	4.61[b]	0	0	0.0016[e]
Age 0+	0.776[b]	0	0	0.0135[f]
Age 1+	0.371[b]	0	0	0.026[f]
Age 2+	4.61[b]	0	0	0.0478[f]
Age 3+	4.61[b]	0	0	0.106[f]

[a] Calculated from assumed survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] (Wapora, 1979). Emerald shiner.
[c] Not a commercial or recreational species, thus no fishing mortality.
[d] Weight calculated from length using the formula for emerald shiner: $(1.144x10^{-4})*Length(mm)^{2.922}$ = weight(g) (Fuchs, 1967).
[e] Length assumed based on (Trautman, 1981).
[f] Length from (Trautman, 1981).

Table I1-13: Smallmouth Bass Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[d]	Weight (lb)[e]
Eggs	1.9[a]	0	0	0.000000331[f]
Larvae	2.7[b]	0	0	0.0000198[f]
Age 0+	0.446[a]	0	0	0.0169[g]
Age 1+	0.86[c]	0.23	0.5	0.202[g]
Age 2+	1.17[c]	0.322	1	0.518[g]
Age 3+	0.755[c]	0.208	1	0.733[g]
Age 4+	1.05[c]	0.288	1	1.04[g]
Age 5+	0.867[c]	0.238	1	1.44[g]
Age 6+	0.867[c]	0.238	1	2.24[g]
Age 7+	0.867[c]	0.238	1	2.56[h]
Age 8+	0.867[c]	0.238	1	2.92[h]
Age9+	0.867[c]	0.238	1	3.3[g]

[a] Calculated from survival (Carlander, 1977) using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Bartell and Campbell, 2000.
[c] Carlander, 1977.
[d] Recreational species. Fraction vulnerable assumed.
[e] Weight calculated from length using the formula: $(2.494x10^{-5})*Length(mm)^{2.917}$ = weight(g) (Froese and Pauly, 2001).
[f] Length from Wang (1986a).
[g] Length from Carlander (1977).
[h] Length assumed based on Carlander (1977).

Table I1-14: Smelt Parameters

Stage Name	Natural Mortality (per stage)[a]	Fishing Mortality (per stage)[a]	Fraction Vulnerable to Fishery[b]	Weight (lb)[c]
Eggs	11.5	0	0	0.0000000115[d]
Larvae	5.5	0	0	0.00000233[d]
Age 1+	0.4	0.03	0.5	0.0195[e]
Age 2+	0.4	0.03	1	0.041[f]
Age 3+	0.4	0.03	1	0.177[f]
Age 4+	0.4	0.03	1	0.338[g]
Age 5+	0.4	0.03	1	0.537[g]
Age 6+	0.4	0.03	1	0.597[g]

[a] Spigarelli et al., 1981.
[b] Commercial and recreational species. Fraction vulnerable assumed.
[c] Weight calculated from length using the formula for rainbow smelt: $(5.23 \times 10^{-6}) * \text{Length(mm)}^{3.114}$ = weight(g) (Froese and Pauly, 2001).
[d] Length for rainbow smelt from Able and Fahay (1998).
[e] Length assumed based on Able and Fahay (1998) and Scott and Scott (1988).
[f] Length for rainbow smelt from Scott and Scott (1988).
[g] Length assumed based on Scott and Scott (1988).

Table I1-15: Sucker Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[b]	Fraction Vulnerable to Fishery[c]	Weight (lb)[d]
Eggs	2.05[a]	0	0	0.0000000135[e]
Larvae	2.56[a]	0	0	0.00000198[e]
Age 0+	2.3[a]	0	0	0.000145[f]
Age 1+	0.274[b]	0.274	0.5	0.0447[f]
Age 2+	0.274[b]	0.274	1	0.249[f]
Age 3+	0.274[b]	0.274	1	0.305[f]
Age 4+	0.274[b]	0.274	1	0.609[f]
Age 5+	0.274[b]	0.274	1	0.823[f]
Age 6+	0.274[b]	0.274	1	0.929[f]

[a] Bartell and Campbell, 2000.
[b] Bartell and Campbell, 2000. Assumed half of total mortality was natural and half was fishing.
[c] Commercial species. Fraction vulnerable assumed.
[d] Weight calculated from length using the formula for river carpsucker: $(6.130 \times 10^{-6}) * \text{Length(mm)}^{3.099}$ = weight(g) (Froese and Pauly, 2001).
[e] Length assumed based on Carlander (1969).
[f] Length from Carlander (1969).

Table I1-16: Sunfish Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[d]	Weight (lb)[e]
Eggs	1.71[a]	0	0	0.00000000736[f]
Larvae	0.687[b]	0	0	0.000000994[f]
Age 0+	0.687[b]	0	0	0.000878[g]
Age 1+	1.61[a]	0	0	0.00666[g]
Age 2+	1.61[a]	0	0	0.0271[g]
Age 3+	1.5[c]	1.5	0.5	0.0593[g]
Age 4+	1.5[c]	1.5	1	0.0754[g]
Age 5+	1.5[c]	1.5	1	0.142[g]
Age 6+	1.5[c]	1.5	1	0.18[g]
Age 7+	1.5[c]	1.5	1	0.214[g]
Age 8+	1.5[c]	1.5	1	0.232[g]

[a] Calculated from survival for pumpkinseed (Carlander, 1977) using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Calculated from extrapolated survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Calculated from survival for pumpkinseed (Carlander, 1977) using the using the equation: (natural mor0tality) = -LN(survival) - (fishing mortality). Assumed half of total mortality was natural and half was fishing.
[d] Recreational species. Fraction vulnerable assumed.
[e] Weight calculated from length using the formula for pumpkinseed: $(3.337 \times 10^{-6}) * \text{Length(mm)}^{3.262}$ = weight(g) (Froese and Pauly, 2001).
[f] Length for pumpkinseed from Bartell and Campbell (2000).
[g] Length for pumpkinseed from Carlander (1977).

Table I1-17: Walleye Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[d]	Weight (lb)[e]
Eggs	1.05[a]	0	0	0.00000000506[f]
Larvae	3.55[b]	0	0	0.0000768[g]
Age 0+	1.93[b]	0	0	0.03[g]
Age 1+	0.7[c]	0.1	0.5	0.328[g]
Age 2+	0.7[c]	0.1	1	0.907[g]
Age 3+	0.7[c]	0.1	1	1.77[g]
Age 4+	0.7[c]	0.1	1	2.35[g]
Age 5+	0.7[c]	0.1	1	3.37[g]
Age 6+	0.7[c]	0.1	1	3.97[g]
Age 7+	0.7[c]	0.1	1	4.66[g]
Age 8+	0.7[c]	0.1	1	5.58[f]
Age 9+	0.7[c]	0.1	1	5.75[g]

[a] Calculated from survival (Carlander, 1997) using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Bartell and Campbell, 2000.
[c] Thomas and Haas, 2000.
[d] Recreational species. Fraction vulnerable assumed.
[e] Weight calculated from length using the formula: $(2.297 \times 10^{-6}) * \text{Length(mm)}^{3.23}$ = weight(g) (Froese and Pauly, 2001).
[f] Length assumed based on Carlander (1997).
[g] Length from Carlander (1997).

Table I1-18: White Bass Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[d]	Fraction Vulnerable to Fishery[e]	Weight (lb)
Eggs	2.3[a]	0	0	0.0000000266[f]
Larvae	4.61[b]	0	0	0.00000174[f]
Age 0+	1.39[b]	0	0	0.174[g]
Age 1+	0.42[c]	0.7	0	0.467[g]
Age 2+	0.42[c]	0.7	0.5	0.644[g]
Age 3+	0.42[c]	0.7	1	1.02[g]
Age 4+	0.42[c]	0.7	1	1.16[g]
Age 5+	0.42[c]	0.7	1	1.26[g]
Age 6+	0.42[c]	0.7	1	1.66[g]
Age 7+	0.42[c]	0.7	1	1.68[h]

[a] Calculated from assumed survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Calculated from survival (Geo-Marine Inc., 1978) using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Froese and Pauly, 2001.
[d] McDermot and Rose, 2000.
[e] Commercial and recreational species. Fraction vulnerable assumed.
[f] Weight calculated from assumed length based on (Carlander, 1997) using the formula: $(1.206 \times 10^{-5}) * \text{Length(mm)}^{3.132} = \text{weight(g)}$ (Van Oosten, 1942).
[g] Carlander, 1997.
[h] Assumed based on Carlander (1997).

Table I1-19: Whitefish Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[d]	Weight (lb)[e]
Eggs	2.3[a]	0	0	0.000000252[f]
Larvae	8.2[b]	0	0	0.000171[g]
Juvenile	0.25[c]	0	0	0.0117[g]
Age 1+	0.25[c]	0.997	0.5	0.705[f]
Age 2+	0.25[c]	0.997	1	1.27[f]
Age 3+	0.25[c]	0.997	1	2.32[f]
Age 4+	0.25[c]	0.997	1	2.85[f]
Age 5+	0.25[c]	0.997	1	3.52[f]
Age 6+	0.25[c]	0.997	1	4.09[f]
Age 7+	0.25[c]	0.997	1	4.76[f]
Age 8+	0.25[c]	0.997	1	5.7[f]
Age 9+	0.25[c]	0.997	1	5.73[h]
Age 10+	0.25[c]	0.997	1	5.85[f]
Age 11+	0.25[c]	0.997	1	6.1[f]
Age 12+	0.25[c]	0.997	1	6.83[f]
Age 13+	0.25[c]	0.997	1	7.11[f]
Age 14+	0.25[c]	0.997	1	7.29[f]
Age 15+	0.25[c]	0.997	1	7.32[h]
Age 16+	0.25[c]	0.997	1	8.66[f]

[a] Calculated from assumed survival using the using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Froese and Pauly, 2001.
[c] Schorfhaar and Schneeberger, 1997.
[d] Commercial and recreational species. Fraction vulnerable assumed.
[e] Weight calculated from length using the formula for lake whitefish: $(4.721 \times 10^{-6}) * \text{Length(mm)}^{3.152} = \text{weight(g)}$ (Froese and Pauly, 2001).
[f] Length from Scott and Crossman (1998).
[g] Length from Fish (1932).
[h] Length assumed based on Scott and Crossman (1998).

Table I1-20: Yellow Perch Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[d]	Weight (lb)
Eggs	2.75[a]	0	0	0.0000022[e]
Larvae	3.56[b]	0	0	0.00000384[b]
Age 0+	2.53[b]	0	0	0.0232[b]
Age 1+	0.361[b]	0	0	0.0245[b]
Age 2+	0.248[b]	0	0	0.0435[b]
Age 3+	0.844[b]	0.36	0.5	0.0987[b]
Age 4+	0.844[b]	0.36	1	0.132[b]
Age 5+	0.844[b]	0.36	1	0.166[b]
Age 6+	0.844[b]	0.36	1	0.214[b]

[a] PSEG, 1999c.
[b] Wapora, 1979.
[c] Thomas and Haas, 2000.
[d] Recreational species. Fraction vulnerable assumed.
[e] Assumed based on Wapora (1979).